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Municipal Journal & Public Works.

City County State

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Contributed Articles and Reports

Contributions suitable for this paper, either in the form of special articles or as letters discussing municipal matters, are invited and paid for.

City officials and civic organizations are particularly requested to send to Municipal Journal and Public Works regularly their annual and special reports.

Information Bureau

The Information Bureau, developed by twenty-one years' research and practical experience in its special field, is at the command of our subscribers at all times and without charge.

Contents of This Issue.

Publication Delayed by Strikes

In the September 27th issue we stated that a strike among the printers might delay the appearance of the following issues. The strike occurred on October 1st and is still on. All of the periodical and book publishers in the city are involved, and they and the employing printers have been working together and in harmony to bring about a settlement. After waiting for more than three weeks, the publishers decided on October 24th that each publisher, through his printer or with his cooperation, should make an effort to obtain the printing of his publication at the earliest possible date. Municipal Journal and Public Works is among the fortunate ones which were able to begin at once the printing of the delayed issues, and we will publish them as rapidly as possible until we have caught up.

For the appearance of this and the next two or three issues we shall have to ask that allowances be made. The printers who are taking over the work temporarily have not the type or other facilities for doing the work just as it has heretofore been done, nor has their previous experience been along just this line of work. The appearance of the pages will be somewhat different, therefore, and there will necessarily be fewer of them in each issue. The reduction in size will be secured chiefly by omission of the news matter, for as the first issue or two will be several weeks late, this will have lost much of its news value.

We trust that under the circumstances our readers will overlook any shortcomings for the time being, and will realize that we are doing our best to get to them, as soon as possible, as good a paper as adverse conditions permit.

The Birmingham Sewage Experiments

Most engineers interested in sewage treatment have known for some time of the experiments being carried on in Manchester, and the report of Mr. Watson in this issue, giving what may be considered the official conclusions as to this method of treatment, will be of interest to all. Apparently the results obtained in Birmingham in sludge digestion were very similar to those obtained in a well-operated Imhoff tank, and a comparison between the two immediately suggests itself.

In several cases recently engineers have reported that the Imhoff tank did not appear to be feasible for the particular locations under consideration because of the great expense of excavating to the depth required by a two-story tank. In the Birmingham plant the two units of the two-story tank are placed side by side rather than being superposed, whereby the necessity for deep excavation is eliminated. Pumping the sludge, however, seemed to be necessary; but it was believed by Mr. Watson that the cost of this was more than compensated by the advantages.

Certainly it would seem as though the idea of utilizing the Birmingham system as a substitute for the Imhoff tank, where the construction features of the latter involve prohibitive expense, is well worth consideration by engineers in view of the excellent results that are reported from the latest modifications of the treatment that has been carried on in the Birmingham tests.

THE UTILIZATION OF SEWAGE SLUDGE*

Summary of Results and Conclusion from Experiments Conducted for Several Years at Birmingham, England—Digestion of Sludge in Separate Tanks in Two Stages—Avoidance of Odor.

By JOHN D. WATSON, M.INST.C.E.

Real progress in the treatment of sewage sludge was made in Birmingham when it was first realized that (a) sewage was inoffensive to the sense of smell until putrefactive changes began, and (b) that foul-smelling sludge ceased to offend the olfactory nerves when putrefactive changes had run their course.

To bury sludge as it leaves the sedimentation tanks is to take the most efficient method of retaining the foul odor which characterized it when it left the tank. Sludge was unearthed at Saltley recently after thirty years, which proved that burial *per se*, even if the sludge is deposited near the surface of the ground, where nitrifying organisms are most active, is not sufficient to free it from objectionable smell.

With the idea of carrying on the functions of oxidizing the liquid of sewage and the septicization of sludge simultaneously, Dr. Imhoff patented a two-story tank, which had the Travis hydrolytic tank for its prototype. The lower chamber of this tank is for fermentation, and the upper one for sedimentation. The Birmingham plan provides two separate shallow tanks, one placed alongside the other, to do the same work.

*A paper before the forty-sixth annual general meeting of the Institute of Municipal and County Engineers, June, 1919, slightly condensed.

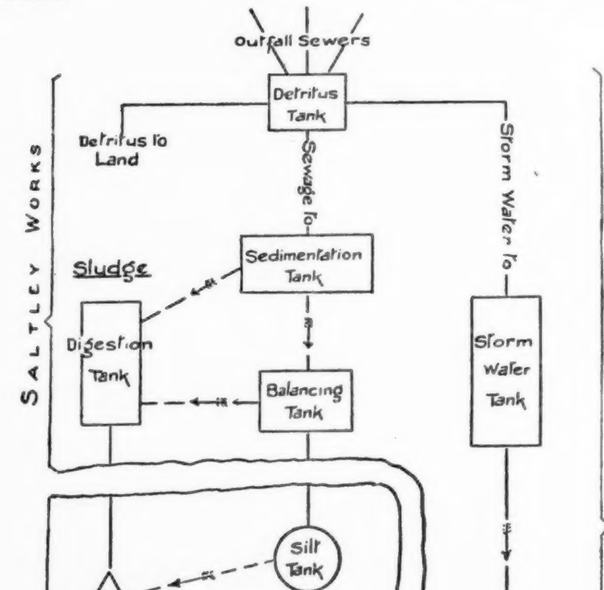


DIAGRAM ILLUSTRATING METHOD OF PURIFYING BIRMINGHAM SEWAGE.

The Minworth plant is five miles from the Saltley, the sewage flowing and the sludge being pumped from the latter to the former.

In comparing the two, it is claimed for the Birmingham method that the cost of construction is less; it is better under control; the results obtained under normal conditions equally good, and under abnormal conditions—such as obtain in time of rainfall—much better. Operating costs of the Birmingham method are greater than by the Imhoff method, but the latter is distinctly inferior when large quantities of antiseptic substances like gas tar, arrive unheralded at the outfall works. It is desirable to isolate highly antiseptic matter instead of automatically distributing it over the whole surface of the fermentation chamber, or lower story of the Imhoff tank, where it tends to inhibit the action of the anaerobic organisms upon which the success of the process depends.

There are no doubt advantages and disadvantages based upon physical and topographical circumstances pertaining to both methods which an engineer must appraise in determining the design most suited to individual cases, but the author maintains that the shallow flat tank has more to commend it than the other.

A marked feature of the Birmingham installation is the temporary character of the sludge digestion tanks, many of which are formed by a combination of excavation and embankment; the material employed to make the latter is composed chiefly of engine ashes laid on the soft material from the excavation. No lining of flagstones or inside coating of any kind is given to these improvised tanks, the sludge itself having been sufficient to seal all the interstices of the ash embankments. These tanks or lagoons are sufficient to effect the main objects in view, but they do not admit of the advantages of quick and thorough emptying and refilling associated with well-built vertical-sided tanks. Still, when cheapness of construction is essential, as, for instance, when one is experimenting, this form of construction has much to commend it.

After the inflowing sewage from a population of about 750,000 persons passes through the detritus pit, from which the heavy solids are dredged by an electrically-operated dredger, it flows through five sedimentation tanks working in parallel and subsequently through what is called a balancing tank. Each of the former has a capacity of slightly more than 1,000,000 gallons and the latter 7,000,000 gallons, together 12,500,000 gallons, or about half the dry-weather flow coming to this the main outfall of the Drainage Board's main sewerage district.

Each of the 5,000,000-gallon sedimentation tanks is cleaned every week, and the balancing tank, which is run in series with them, less frequently.

The crude sludge—92.5 per cent water—arrested in the Saltley sedimentation tanks alone amounted to 1,523,000 cubic yards during the past four years, or an average of 380,750 cubic yards per annum, the whole of which was transferred to 39 sludge digestion tanks or lagoons possessing a total capacity equal to 28,250,000 gallons.

The total dry solid matter removed from all tanks at Saltley, etc., outfalls, including Minworth tanks, in the four years 1915-1918 amounted to 110,000 tons, or 75 tons per diem, all of which was transferred to the sludge digestion lagoons.

The density of the sludge removed chiefly depends on the frequency of the cleaning operation. During 1915 these tanks were emptied once in two or three weeks, when the average water content of the sludge was 87 per cent, whereas the weekly cleaning during the four years

under consideration yielded sludge with a water content of about 92.5 per cent.

Theoretically, the more frequent the emptying operations the better, but economy suggests a curtailment of the operation when temperatures are low. When temperatures are high there should be frequent cleaning, and the strictest avoidance of obstructions in the sewers should be encouraged if objecionable odor is to be reduced to a minimum. This becomes even more imperative as the area of a drainage district increases.

It has been shown that with care the putrefaction of the liquid can be prevented, but the successful digestion of the sludge has proved to be a more difficult problem; still, with accumulated experience and the expansion of the tank area the operations at Birmingham have been conducted with greater ease, economy and success as time went on.

The digestion tanks used at first consisted of an existing installation of 20 tanks, 16 of them with an aggregate capacity of 4,539,500 gallons and 4 of them with an aggregate capacity of 2,723,680 gallons, all so thoroughly well built and equipped with emptying arrangements that they are easily the best of the installation of 39 tanks.

For the first two years the digestion operations were conducted in two stages in this installation of 20 tanks. The 16 tanks were used for primary digestion and the 4 larger ones for the secondary digestion. Two stages were adopted, as it was found in the very early days that vigorous fermentation was the better maintained thereby and tank space was saved to such an extent by pumping from one tank to another that the second pumping was economical when compared with the prospect of an increased capacity; it was soon discovered also that inoculating raw sludge with ripe sludge thus obtained from the secondary tanks had an excellent effect upon the "speeding-up" process. Further, temperature was too obviously a beneficial factor in the success of the process to be ignored.

The following mode of operation was adopted at the beginning of 1912 and has been continued ever since. In cold weather the sludge is transferred from the particular sedimentation tank whose turn it is to be cleaned out into the selected digestion tanks (generally five or six in number) by the main set of pumps; simultaneously some of the ripest of the available sludge is pumped by a small pump into the same delivery main in the proportion of 1 to 4, thus inoculating at the earliest possible moment the fresh sludge with the fermentative organisms; in addition steam from one of the Lancashire boilers is injected into the delivery main to produce temperature conditions most favorable to fermentation.

In moderately warm weather steam injection is abandoned, and during the heat of summer neither inoculation nor steam injection are resorted to. The biological factor governing the digestion process must necessarily be somewhat complicated, and it is only by the most careful observation of the conditions which bring about the right balance of living organisms that success can be achieved.

The following tables of analyses supplied by F. R. O'Shaughnessy, consulting chemist, indicate two different sets of conditions, Table A where the fermenting mass was very offensive, and Table B where the vigorous fermenting mass was quite inoffensive.

TABLE A.

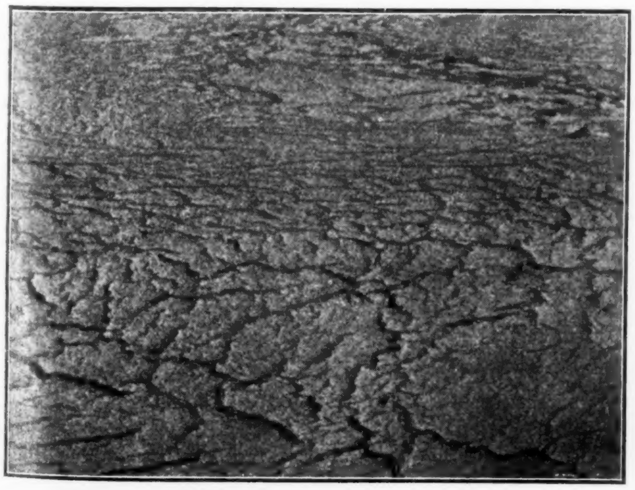
		Total Counts. Organisms per c.c.
Gelatin-Peptone-Bouillon at 20°C	Mean	24,000
Agar-Peptone-Bouillon at 37° C	"	130,000,000
Coli group		7,000
Proteus group (including **Enteritidis sporogenes**)		100,000
Denitrifiers		500
Fat-splitting organisms		10,000
Cellulose		100,000

TABLE B.

	Total Counts.	
	Aërobic. per c.c.	Anaërobic. per c.c.
G.P.B. at 20° C	52,000,000	15,700,000
A.P.B. at 37° C	5,000,000	3,000,000
Coli group	60,000	
Proteus group	100,000 at least	
Denitrifiers	100,000 "	
Fat-splitting organisms	100,000 "	
Cellulose organisms	50,000	

Having obtained the right bacterial balance, so to speak, the aim of the management is to maintain it. What looks like an inexhaustible volume of sludge which constantly varies in character (about 1,000 tons per day) is drawn to a locality literally surrounded with dwelling-houses, factories, etc., and formerly gave rise to loud and serious complaints. Now, this large mass of foul material is treated on the same site without any offence whatever.

Variation in the character of sludge is only to be looked for in a great manufacturing district where there are no restrictions on the discharge of trade waste into sewers; but these are sometimes very serious in their consequences, as when large discharges of tarry products from coal, water, or producer gas-plants suddenly appear.



SLUDGE AFTER THREE DAYS IN THE DRYING BED.

SLUDGE AFTER THIRTEEN DAYS IN THE DRYING BED.

The saving factor in the situation is the system of separate sedimentation and separate sludge-digestion tanks, so that whether it is a sudden increase of volume due to rainfall or an overpowering mixture of antiseptics, the large number of sludge tanks in all states of fermentation renders the scheme at once elastic and manageable. The capacity of the whole of the sludge-digestion apparatus is equal to 165,000 cubic yards or 28,000,000 gallons, which, with the present demand, means a time retention of between four and five months.

The average analysis of the sludge for the four years 1915-1918 is as follows:

Water	92.5 per cent
Dry solid matter	7.5 "
Specific gravity of wet sludge (estimated)	1.0256 "
Specific gravity of dry solid matter	1.50 "

and the average analysis of the dry solid matter is as follows:

Matter volatile at red heat	58.5 per cent
Matter non-volatile	41.5 "
Total nitrogen	2.71 "

The fatty matter in the crude sludge varies greatly, the actual limits for the figures in the analyses made being from 16.85 per cent to 31.00 per cent, with an average of 22.20 per cent. These figures represent a total ether extract, but it is probable that about 2 per cent of this ether extract is resinous matter, and the real fatty matter will be represented by an average figure of about 20 per cent.

The improvised lagoons at Minworth, which form part of the installation of 39 tanks, were formed by surplus spoil from the bacteria bed site and dry sludge from the drying bed area, and they perform at least three functions:

1. They give time for the completion of the fermentation process.
2. They permit, with almost no detriment to the installation, the admission of humus from the bacteria beds, flushings from tanks, and flushings from distributing pipes.
3. They act as decanters of supernatant water.

The first is of course the primary purpose of the lagoon.

Imhoff found that he required his fermentation chambers to be large enough to contain from three to six months' storage of sludge. The author finds that the average requirement for the past four years has been equal to a storage of four months.

It has been proved abundantly that sludge dries more readily when the digestive process has been carried to exhaustion before it is pumped to the drying area; hence the economy of ample tankage.

The second is a most important function. The so-called "humus" excreted from a bacteria bed, like the sludge discharged from an activated sludge plant, is a valuable fertilizer, but so far has not been utilized because of its "emulsive" character and the difficulty and expense of dewatering.

When nearly 1,000 tons of it have to be got rid of each day the importance of dewatering cannot be over-estimated. To pump it back to the beginning of the process (the detritus pit) is a practicable solution in most cases, but not when it has to be forced through five miles of pumping main. Mixing it with the sewage as it entered the silt tanks just before spraying it over the bacteria beds was tried, but was found impracticable owing to the fibrous growths which were introduced into the distributors. Allotting a lagoon to itself with the view of trying to separate solids from liquid by mechanical action alone was not a success, and of all the various proportions of humus and ripe sludge mixtures made with the view of encouraging separation the best result was obtained where the smallest quantity of the former was mixed with the largest proportion of the latter. This is understandable when one remembers that the "humus" contains 5 to 6 per cent of nitrogen and the oxidized sewage effluent conveying it has in its composition a sufficient quantity of nitrates to arrest putrefactive tendencies.

How long this humus emulsion will remain a jelly it is difficult to say, but there are samples on the works which still retain that jelly-like character after exposure to the atmosphere for six years.

The third is not the least important function of this lagoon. Water rises to the surface when fermentation is exhausted and frequently when it is quiescent, when it may be decanted direct to the filter-bed. When one remembers that by reducing a 90 per cent to an 80 per cent sludge one gets rid of one-half its water content, the importance of decanting as much liquid as possible is evident. It has also been proved that additional advantage is gained by providing deep lagoons, thus supporting A. J. Martin's theory that the deeper the tank the denser the sludge obtained; at the same time the benefits in this respect must be measured by the degree of emulsification obtaining.

The rotted sludge or residuum of the fermentation process is pumped direct to the drying-beds which are in the immediate vicinity. They consist of plots of engine ashes 150 feet square and have a total area of 54 acres. All the plots are under-drained with 4-inch agricultural tile-pipes in herringbone fashion toward a main leader which conveys the drainage to a well, whence it is pumped, with water decanted from the lagoons, to a percolation filter made for the purpose.

Each drying-bed is formed by earthen banks about 2 feet high. The area is provided with a system of permanent 2-feet gauge tramways—laid to suit loco haulage, both steam and electric battery locos—and provided with conveniently placed turnouts and crossings to allow temporary rails to be laid through the beds for the collection of dried sludge.

The time required for drying varies with the weather, but in dry weather it quickly cracks and admits air. Figure 2 shows the appearance of the sludge three days and Figure 3 thirteen days after it has been deposited. When it has become sufficiently dry to be lifted in lumps it should be conveyed to the tip, as it is troublesome to the workmen when it gets into the dry-as-dust state; indeed, eye protectors have had to be provided in such cases. The embankments which are being formed of the dry sludge are about 15 feet in height. When the lumps are tipped over the embankments the drying is completed, and the estimations for calorific value dried at 212° F. give an average of 4,500 B.T.U., or something similar to the calorific value of ordinary house and shop refuse as burnt in a destructor.

It should be clearly understood that this process of sludge treatment is put forward as a complete process in itself, just as the Imhoff tank process was put forward by the German engineer, but without in this case any suggestion that the effluent from the sedimentation tank could be discharged into a stream. It effectually converts an exceedingly offensive colloidal mass of sewage into a dry substance, which might be kept in one's office for years without giving off more odor than would garden soil in similar circumstances. This conversion is accomplished without nuisance at any stage, and judging by

pre-war costs the expense is similar to that incurred by London and Manchester. The figures for cost given by the Royal Commission on Sewage Disposal are as follows:

	Pence per ton (90 per cent water)
Sea disposal	4.1 to 6.9
Trenching in soil	4.0 to 7.0
Pressing (for large towns)	7.7 to 12.6
Pressing and burning	18.0

Comparing sludge digestion at Birmingham with these figures, and assuming a wet sludge containing 90 per cent water, it is approximately 5 pence per ton.

Cost figures are bound to vary, and in comparing sludge costs care should be taken to see that the percentage of water in the sludges coincides. Another statement showed the cost to be 6.3 pence per ton of sludge (86.6 per cent water) made up as follows:

(1) Cost of tankage, digestion and pumping to drying beds:

	£	s.	d.
Wages	1,622	10	0
Coal	710	5	0
Stores, etc	90	9	0
Repairs, etc.	22	10	0
Water charges	75	5	0
	£2,520	19	0

The volume of sludge dealt with was 260,000 cubic yards. Approximate cost per cubic yard of wet sludge, 2.25 pence.

(2) Cost of drying sludge, lifting and carrying to tip:

28,816 cubic yards of dry sludge	£990 17 7
Cost of cubic yard of dry sludge	8.3 pence
Cost of cubic yard of wet sludge	2.5 pence

By adding (1) and (2), wet sludge 86.6 per cent water equals 4.7 pence per cubic yard, or 6.3 pence per ton.

That the scheme as illustrated at Birmingham is as perfect as it might be made the author does not claim. It began as an experiment, and has been extended from time to time always as an experiment. The great tanks and lagoons, with a total capacity of 28,000,000 gallons, have been built in a temporary manner out of revenue as necessity has arisen, and the design or lay-out (apart from the biological side), if design it may be called, is obviously an improvization to meet current requirements and to obtain knowledge, rather than a consistent ideal based on some well-tested prototype. Indeed, our calculations were so far out of truth originally that at one time we hoped that by an intensive fermentation at Saltley the 20 brick-built tanks, which have a capacity of 7,000,000 gallons, would suffice for treatment of all the sludge arriving there.

The adoption of the scheme which has been described was due to the impossibility of septicizing sewage and sludge together without nuisance. It has accomplished what it essayed to do, thanks chiefly to the consistent work of our chemist and superintendent of works, but its final success is dependent upon the profitable utilization of the nitrogen, which up till now has been lost sight of in the predominating desire to get rid of sludge with a minimum of nuisance.

PROFITABLE UTILIZATION.

With the object of recovering from the dry sludge nitrogen and other products of distillation, a boatload of it has been sent to the Saltley gas works each week for some time. Absolutely trustworthy results will not be available until more producers are installed there, but the gas works engineer, Mr. Chaney, says that he is willing to give 3s. 6d per ton for it, delivered in boat at the Saltley gas works.

Just before the war began the Drainage Board entered into a contract with the Anglo-Continental Fertilizers Syndicate, Ltd., by which that company agreed to treat about one-fifth of the Birmingham sludge with the view of recovering from it both fats and fertilizers, but chiefly fertilizers. The outbreak of war upset the project for the time being, the Treasury absolutely forbidding the expenditure of money on work of this kind, with the immediate result of encouraging the gas works experiments which have turned out as well, and now that the war is over the company's plans are to be put into the hands of builders whose initial work is essential before the company can begin to fulfill its agreement.

The scheme put forward by the company is one which the author hopes to deal with in a subsequent communication, but briefly it is as follows: The sludge is warmed to a temperature of about 90° F., when a small amount of yeast (from 0.5 to 1 per cent) is added and the mixture allowed to remain in suitable tanks for a period of twenty-four hours, provision being made to keep the mixture at the optimum temperature of 90° F. As the result, certain important changes take place in the character of the sludge, the particles coagulate into a compact mass which separate from the water and rise to the surface, being buoyed up by the gases evolved from the ferment. The water is run off through perforated pipes, which, while allowing the liquid to pass, holds back the thick sludge and enables the separation of the water from the sludge to be effected easily and quickly, and with a minimum of labor.

Some changes other than physical are brought about by the process and the colloids are affected to some extent, with the result that the sludge is improved for subsequent treatment.

Fermentation reduces the sludge, say, from 90 per cent water content—which is the average of ordinary sludges—to 80 per cent, equal to the reduction of one-half the water content, thus reducing the cost of treatment. The operation being a static one, the cost of working is small.

The heat used for warming the sludge is obtained from the drying process, and may be either furnace gases, or hot air and vapor from the dryers, which would be otherwise wasted.

The further treatment of the sludge depends to some extent on local conditions. Moisture may be gotten rid of by treatment in dryers heated by means of hot air, by direct heat, or in steam-jacketed drying-pans. It can also be reduced to about 50 per cent by an intermediate process of pressing in ordinary sludge presses, and the cake, after being broken into small pieces, finally dried to a moisture content of from 10 to 15 per cent.

The product is reduced to a fine powder for easy application to the land; it is then in a suitable condition for further treatment if grease is present in sufficient quantity to justify its recovery.

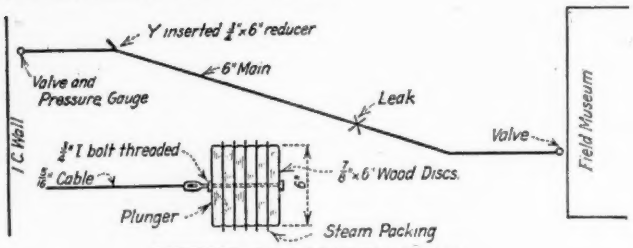
This process is too complicated to be disposed of in a few sentences, and the author proposes to give the Institution a detailed account of it when the works are erected and in full operation.

LOCATING WATER MAIN LEAK.

A leak in a 6-in. water main buried under a 30-ft. fill in front of the Field Museum in Chicago was located by a novel method, which is described in "Successful Methods" as follows:

The water was cut off at the valve near the Illinois Central right of way retaining well shown in the figure. The pipe was cut and a Y laid on its back was inserted, through which the diaphragm plunger shown in the figure was passed. This plunger was made of six 1-in. discs with rubber steam packing between and a threaded eye bolt run through the center to which a 5-16-in. wire cable was attached. The end of this cable was first threaded through a ¾ by 6 in. reducing bushing with the ¾-in.

opening packed to make a water tight joint around the cable, after which the reducer was placed in the open end of the Y. A pressure gauge was put in at the valve near the Illinois Central wall.



METHOD OF LOCATING LEAK.

Water was turned on, the valve at the building closed, and about 6-lb. pressure obtained in the pipe by opening slightly the valve at the Illinois Central wall. The plunger moved along the inside of the main until the leak was reached, when the pressure disappeared and the plunger stopped moving. This located the leak, the distance from the Y being determined simply by measuring the cable as it was paid out. The plunger stuck only once or twice, necesistating an increase of the pressure to 18 lb. until it started again.

The method was devised by Howard White, of Graham, Anderson, Probst & White, architects, of Chicago, and was executed by R. J. Powers, the plumbing contractor.

ADVANTAGES AND LIMITATIONS OF COMMISSION GOVERNMENT.

A bulletin of the Bureau of Municipal Research, of Toronto, Ontario, has just been issued discussing the subject of Commission Government, briefly "in response to the requests of various citizens"; the purpose being to describe, in a series of bulletins, the forms of city government in vogue in Canada and the United States.

The bulletin begins with a brief sketch of the history of Commission Government and a description of what it is, both of which are probably well known to the readers of Municipal Journal & Public Works. Of considerable interest are the opinions given as to the advantages and limitatione of this form of government.

The advantages are stated to be the following:

"1. It simplifies the structure of city government, leads to better financial control, and enables the city to conduct its business more promptly.

"2. By placing each commissioner in charge of a definite department and making him responsible to the people for its proper and intelligent management, it gives conspicuous responsibiltiy and hence accountability of all elected officials to the people.

"3. The Initiative, Referendum and Recall permit actual citizen participation in civic affairs.

"4. It stipulates, for a time at least, citizen interest in civic government."

The limitations are said to be:

"1. The form is not conducive to harmony in the governing body. As each commissioner represents a department, and the five make up an executive body for th ewhole, commissioners quite frequently resent interference by other commissioners with their respective departments. There is the tendency to divide the city into five little governments.

"2. Election is a poor method of obtaining trained and competent officials. The tendency is to elect men who are experts in getting elected and not specialists in administration.

"3. It provides nothing more than an incentive to better service. It gives the officials no new technique and no new method. With some noticeable exceptions, cities show little adminstrative progress under it.

"4. It practically abolishes the office of mayor, and does not provide an apex for the pyramid of local administration. It does not go to the logical conclusion in concentrating responsibility.

"5. A commissioner may just be in process of becoming efficient as an administrative head when he fails of re-election. This unnecessarilyy shortens the tenure of office of heads of departments, who should be permanent as long as good service is given.

"6. Department heads cannot give all their attention to their departments, but must invest considerable time and energy on 'mending their fences' for re-election.

"7. Departmbent heads are apt to make appointments coming under their jurisdiction with a view to a possible influence on their own chances of re-election.

"In almost all cases where Commission Government has been adopted the people, under the impression that they were parting with powers formerly possessed, inserted in their government the Initiative, Referendum and Recall. These provide for citizen participation in the government at any time upon petition of a percentage of the voters:

"Initiative—A percentage of the voters may ask the commissioners to pass an act. The latter must then either pass such act or submit it to a general or special election of the citizens.

"Referendum—On demand of a percentage of voters the commission are compelled to put to a vote of the people a law they have passed before the same can be enforced.

"Recall—A percentage of the voters may compel the electors to vote on whether or not a member of the commission shall be recalled.

FIRE ALARM AND POLICE CONTROL

The first fire-alarm telegraph system was installed in Boston in 1852. In 1917 there were 1285 such systems, and also 383 police-patrol systems and 45 combined fire-alarm and police-patrol. This does not include adaptation of local telephone service to such uses, but only those systems in which the boxes and wires are used exclusively of sending signals to a central office. These and the remaining figures in this article are found in a report for 1917 of the U. S. Census Bureau.

The 1713 systems above referred to represent 1349 cities and towns; of which 921 reported only fire-alarm systems, 19 only police patrol, 364 reported both, and 45 combined and interchangeable systems.

In fire-alarm the middle Atlantic states lead with 336 systems, New England had 309, the East North Central had 248, while the smallest number was reported by the West South Central—37. In numbers of police-patrol systems, the geographical divisions are arranged in the same order.

During the ten years 1907 to 1917 the number of systems increased from 1157 to 1713. During this period the miles of overhead wire used increased from 42,796 to 55,937, while the miles in underground subways or conduits increased from 28,016 to 51,721; or 30.7% and 84.6% respectively. The number of boxes or signaling stations increased from 62,504 to 94,853, being 0.88 per mile of wire in each case.

In numbers of fire-alarm systems the leading states rank as follows: Massachusetts, 140; Pennsylvania, 128; New York, 121; New Jersey, 87; California, 76; Michigan, 63; Ohio, 55.

In numbers of police-patrol systems the states rank as follows: Massachusetts, 54; New York, 38; New Jersey, 37; Pennsylvania, 34; Ohio, 30; California, 17; Illinois, 16; Connecticut, 15; Michigan, 14; Indiana, 13; Wisconsin, 11; all others under 10.

In numbers of boxes or signaling stations, New York leads with 12,202; Massachusets had 10,783; Pennsylvania,

9,754; Ohio, 6,573; Illinois, 6,045; New Jersey, 5,175; California, 4,943; Michigan, 4,771; Wisconsin, 2,793; Connecticut, 2,682; Indiana, 2,707; Missouri, 2,480. All others were under 2,000.

Perhaps the most important improvement in recent years has been the placing of the wires underground. In 1917, 97.2 per cent. of the underground mileage was in cities of 30,000 inhabitants or more. Detroit led with 9,752 miles of single wire underground; Chicago had 5,192; New York, 4,976; Cleveland, 2,420; Boston, 2,132; Milwaukee, 1,710; Syracuse, 1,476; Philadelphia, 1,299; Pittsburgh, 1,260; Buffalo, 1,065; Washington, 1,033. No other cities had over 1,000 miles.

In the District of Columbia, 89.2 per cent. of the total mileage of wires was underground; in Michigan, 69.5 per cent; in Nebraska, 69.2; in Maryland, 68.1; in Wisconsin, 64.8; in Illinois, 59.5; in New York, 56.7; in Minnesota, 53.2; in Ohio, 52.0. In all others the percentage was under 50.

NEW ENGLAND WATER WORKS ASSOCIATION CONVENTION

THE THIRTY-EIGHTH ANNUAL CONVENTION AT ALBANY.

Condensed Report of the Several Sessions—Reports of Committees, Papers Read and Discussions—Reservoirs, Standpipes, Mains, Meters, Engines and Other Features Considered.

This convention was held at the Ten Eyck Hotel in Albany, N. Y., on September 30th to October 3rd inclusive. There were 291 registered attendants, of whom 129 were active members. In addition to the opening business session on Tuesday morning, there were nine sessions for the reading and discussion of papers and a tenth session at which moving pictures were shown illustrating manufacturing of steel pipe and others for entertainment purposes only. Two papers were assigned for each session, and the program was carried out with only two or three changes, one being a transposition of papers between Tuesday afternoon and Wednesday evening and another being the omission of the last paper because the author had been and still was on guard duty in Boston, for which, however, another paper was substituted. There was abundance of time for discussion—in fact, it would seem as though the entire program could have been put through in two or two and a half days instead of the four that were only partly occupied, some of the sessions lasting only an hour and a half or two hours, while an average of about three hours each was available.

The meetings were quite well attended, with the exception of the last evening, when only fifteen or twenty were present.

TUESDAY'S SESSIONS

At the opening session, following the address of welcome by the mayor and others in behalf of the city, President Killam delivered the annual address, in which he laid particular stress upon the need that careful watch be kept upon legislation affecting public health, and suggested that the society have a paid assistant secretary to handle its growing business, and that it establish a budget system; also that a committee be appointed to consider changes that should be made in the association's constitution and by-laws.

Reports of the several cities were then called for, but practically all of those submitted were little more than progress reports. The Committee on Awards announced that the Dexter Brackett memorial medal was awarded to D. A. Heffernan, superintendent of the Milton, Mass., water works, for his paper entitled "Practical Methods of Detecting Leaks in Underground Pipes."

On Tuesday evening the president's recommendation that the society adopt the budget system was endorsed by a vote that he appoint a committee of three to formulate and report upon such system, the report to be submitted at the September meeting of the society.

Langdon Pearse, in a communication, suggested that the association consider the question of the creation of a national department of public works, a bill for which is now pending in Congress, and the motion was adopted that a committee of three be appointed by the president to report to the association recommendations regarding action to be taken by the society.

In the afternoon session, Theodore Horton, chief engineer of the New York State Department of Health, described the work being done by that department in the supervision of public water supplies, devoting special attention to the results obtained by such supervision. The engineering division of the department was established in 1906, and in 1917 the typhoid rate began a rapid and uniform drop from its previous average of twenty per 100,000 until it reached six in 1916, with very slight drops in 1917 and 1918. While all of this decrease is not claimed by the department as due to its water-supply work, the records indicate that it can claim a very large part of the credit as resulting from its investigations of water supplies and the giving of advice and securing the adoption of such advice. In 1919, out of 530 water supplies, 130 are treated by filtration or chlorine or both. The population that is furnished purified water is about ten times as great in 1919 as it was in 1907.

Professor William P. Mason gave some suggestions concerning operating swimming pools, using the Rensselaer Polytechnic Institute pool as his chief illustration. He stated that few pools at the present time were operated on the draw and fill principle, but most used the water continuously, purifying it by filtration or other means. At the R. P. I. the water is changed only once a year, being pumped through a filter plant and chlorinated to remove impurities. Soda ash is used to remedy alkalinity. The aim is to use one grain of alum per gallon of water and about six-tenths part per million of hypochlorite. The hypochlorite is applied directly to the tank and not to the small amount that passes continuously through the filtration plant. The water is kept at a temperature of 76 degrees, which is lowered to about 72 degrees on certain occasions such as athletic meets. Color and turbidity he considered dangerous, since the bottom of the pool should be visible at all times, one instance being cited in which a bather lay drowned at the bottom of a pool of turbid water for some time before his absence was noticed. For removing sediment, he recommended drawing this off at the bottom rather than at the sides of the tank. In the R. P. I. tank it is swept onto a grid in the bottom of the tank and drawn off through this. A new device very much like a suction sweeper has been used for removing the sediment in Boston and some other cities. The University of Illinois is using the violet ray for purifying water and New York City has experimented with ozone. Both are very attractive from a theoretical point of view but he considers that their upkeep is quite expensive, chiefly because of the fragile nature of the apparatus.

In the evening J. Waldo Smith, chief engineer of the New York Board of Water Supply, described the Schoharie development of that city's Catskill supply. This is to add to the present supply 250 million gallons daily. The principal features are a reservoir formed by a dam at Gilboa and a tunnel known as the Shandaken tunnel for bringing this water to the existing Ashokan reservoir. The tunnel has been contracted for by the Degnon Contracting Company at $12,138,000 and the dam by the Hugh Nawn Contracting Company for $6,819,000. The tunnel will be about eighteen miles long and will be reached by shafts at the various points where it passes under the valleys between the several mountains. The shafts are fourteen feet in diameter and are lined with concrete and will be left open at the completion of the work. The deepest shaft is 630 feet. All shafts have now been completed except that at the intake.

The next paper described the 10,000,000-gallon covered reservoir of the Dayton water works, which was built in 1917-1918, the most interesting feature of which was the construction of the roof with flat concrete slabs rather than with groined arches, as is customary. Owing to war conditions, only local bidders bid on the contract and none of these was familiar with groined arch construction, and they were therefore willing to submit lower bids on slab construction. Consequently, although the plans had originally called for the groined arches, new plans were prepared and bids invited on the flat slab construction. This type is believed to have a somewhat smaller factor of safety and a shorter life, but the considerable saving in cost was considered to justify adopting it. The paper gave the specifications and general requirements for the construction, a description of the plan employed and of the forms used, described the progress of the work and finally gave the itemized cost. Messrs. Metcalf and Barnes, the authors, presented lantern slides showing the various features of the works.

WEDNESDAY'S SESSIONS

On Wednesday morning Charles W. Sherman presented a paper entitled "Protecting Iron and Steel Standpipes from Corrosin." This paper was based upon a questionnaire sent out by Metcalf & Eddy to which about 150 replies had been received, these giving information concerning the size and age of standpipes in the several cities, when they had been painted, the preparation made for the painting, kind of paint used, cost, and condition of the standpipe at the time of the report. Mr. Sherman was not able to form any positive conclusions from these replies nor to summarize them because of their great variety. Based partly upon these replies and partly upon the carefully studied experiences of the Boston metropolitan district and some others, he has reached the conclusion that red lead properly applied to a perfectly clean surface gives perhaps the best result of any materials that have been tried. This applies to the inside of the standpipe. For the outside there seemed to be no reason for thinking that paints which proved satisfactory on steel bridges would not prove equally so on standpipes. One question brought out the answer that iron pipe could probably go unpainted for a long time with little deterioration, while this would not be true of steel pipe, and no one dissented from this statement.

In the discussion it was stated that New Rochelle, N.Y., had found red lead very successful, the speaker stating that for painting the outside of standpipes he employed ordinary house painters and found that he got as good results as by the use of professional bridge painters at about one-third the cost. Woonsocket reported having one wrought-iron tank and two steel tanks and the latter were much more pitted than the former. Boston uses "Dutch Boy" red lead mixed with litharge (although the manufacturers do not approve of such mixture). The city furnishes the material but has the work of painting done by contract. Of the labor employed in painting, three-fourths is employed on cleaning the inside of the tank and one-fourth in painting it. One tank was painted inside with gilsonite, but the ice, rising and falling with the fluctuation of the weather had scraped all of this off. One member inquired whether air blast had been used for painting tanks and was informed that Fall River had painted a tank in this way in 1912 but not since, although the reason was not stated. This paper will be published in Municipal Journal and Public Works.

Following this, Bertram Brewer, assistant engineer to the Massachusetts State Department of Health, read a paper entitled "Public Control over New Streets, in Relation to Extension of Water Mains." He emphasized the importance of having streets graded and their lines established before water mains were put in, as otherwise it is probable that mains would have to be changed in vertical or horizontal positions later on. He pointed out the great aid which water works superintendents could render in assisting city planning commissions to secure the carrying out of their street plans, by refusing to lay mains in streets which had not been approved by the city planning boards or commissions. Following a discussion of Mr. Brewer's paper, Mr. Saville moved that a committee be appointed to consider the matter of assessing for water works extensions or otherwise collecting cost of the same, and the relation between such extensions and the street layout. Owing to the necessity for adjourning at once, the motion was laid on the table and was taken up on Thursday morning and passed.

The Wednesday morning session had been held in the dining room of the steamer Rensselaer, in which the entire convention spent the morning and afternoon of Wednesday. In the afternoon the session was held on one of the upper decks of the same steamer, Col. F. F. Longley describing the work done in providing water for the American Expeditionary Forces. This was an exceedingly interesting description by the officer in charge. As such service had never before been entrusted to a separate branch, Col. Longley had first to develop an organization from the very beginning. A special water-supply regiment, the 26th Engineers, was organized and recruited. It was considered essential that the control of water-supply work should be geographically constant, and not be in the control of mobile tactical units. The water-supply service was made responsible for the amount and character of the water delivered at the water points, from which points the tactical units obtained their supplies by tank trucks or carts, and beyond these points the medical department was responsible for the quality of the water. The obtaining and purifying of the water and transporting it to the water points involved the use of water-tank trains, purification plants mounted on motor trucks, movable repair shops and the standardizing of pumps, gasoline engines, pipe etc. By these facilities used in large quantities the service was able to perform feats which the French engineers announced were impossible, among these the supplying of the army with water while it was wiping out the St. Mihiel salient, working across a waterless area. At the time of the armistice, plans had been practically completed for doubling the water-supply forces. An illustration of the enormous amounts of materials required is indicated by the fact that just prior to the signing of the armistice an order had been sent to the United States for 4-inch pipe to be supplied at the rate of ninety miles each month.

The evening session was held at the Hotel and H. S. R. McCurdy, division engineer of the Miami Conservancy District, described the hydraulic fill dams being constructed by the district, first showing by means of lantern slides the previously unequalled damage done by the Dayton flood. Work is progressing rapidly on the construction of these dams. By means of slides the general features of the sluice ways and spillways were shown, the means employed for preventing damaging results from the great velocity of the water flowing through the dam at the time of a flood, and several of the other more interesting features. It is calculated that the dams will not be overtopped with water until there is twice as much run-off as flowed off from the respective drainage areas at the time of the Dayton flood.

The paper describing the operation of the drifting-sand filters at Toronto, which had been postponed from Tuesday afternoon, was presented by Norman J. Howard, bacteriologist in charge of the plant, and illustrated by lantern slides. This type of filter was described by Municipal Journal in the issue of November 16, 1918. Mr. Howard presented tables showing the details of operation and the results obtained as to turbidity, bacteria and B. Coli. The average reduction in bacteria was given as 88.4 per cent, and of B. Coli, 96.4 per cent. The chlorinated water showed an average bacterial count of 1.72 per c.c. and only two samples out of 1,900 showed the presence of B. Coli in 1 c.c. He concludes from the experience so far obtained that during the year the composition of the water appears to undergo two distinct changes which make the treatment difficult, that more coagulant is necessary in summer than in winter, and that in using the drifting-sand filter during 1918, satisfactory purification was obtained with the average dose of one grain of alum per gallon. There was some discussion of this paper, chiefly in the form of questions, one being as to the wear of the sand washer, in answering which Mr. Howard showed a part of a sand-washer tube which had been taken out after several months' wear and was exhibited at the meeting, and in which practically no wear was observable.

THURSDAY'S SESSION

Thursday morning's meeting, the only meeting of that day, was down on the program as superintendents' session, and was opened by David A. Heffernan, superintendent of water works of Milton, who read a brief paper on the damaging of hydrants by auto-

mobiles. This was followed by a comparison of experiences by a number of superintendents. Among others, the average cost of repairing was given by several cities at $50 each, $40 to $50 in New Bedford, $40 to $65 in Boston, etc. New barrels were reported as costing $28.50, while Terre Haute repaired broken hydrants by welding at a cost of $5 to $6 each. Milton is now using a sliding-gate hydrant in order to prevent leakage if the hydrant should be broken. Apparently all cities experienced difficulty in collecting the cost of damaged hydrants from those responsible for the breaking. Dow R. Gwinn reported that the Terre Haute Water Company collected in about forty per cent of the cases. Several members apparently made little effort to collect except sending a bill; but one member included in the bill an estimate of the value of water wasted placing the estimate high with a view to reducing it in effecting a compromise on the bill.

Following this, the subject of protective coatings on cast-iron pipes was discussed, the fact being brought out that quite recently several foundries have had an unprecedented experience with such coatings. Although using the same bituminous material obtained from the same plants as heretofore, they have found patches of the coating disappearing from the pipe in a few days or hours after it had been placed in the yards. In some cases where the pipe had been loaded for transportation immediately, it arrived at its destination with these bare spots. No explanation has so far been found for the phenomenon. In the matter of touching up such bare spots after the pipe had left the foundries, it was reported that Boston uses "vulcanite" pipe paint. They had tried red lead on large pipe and found it very successful, first cleaning the pipe with scrapers made of oak or chestnut, followed by wire brushes, then washing out the dust. It was especially necessary to remove all rust and clean out all pitholes or depressions. For cleaning small pipe, brushes of the proper size were fastened to long poles extending each direction from the brush and pulled backward and forward through the pipe, while the paint was applied by an ordinary paint brush fastened on the end of a long pole.

No other subjects were discussed at this session, which adjourned at 10.30. The rest of the day was spent in an excursion to the plant of W. & L. E. Gurley, the Renssalaer Polytechnic Institute and the watershed of the city of Troy, followed in the evening by moving pictures illustrating the manufacture of steel pipe by the National Tube Company.

FRIDAY'S SESSIONS

On Friday morning Paul Lanham, engineer in charge of waste detection at Washington, D. C., described the detection of losses from underground water distribution systems employed in that city. This has been carried on systematically for more than fifteen years and the results are on record and demonstrate the value of the service. The general method of detecting leaks by dividing the city into districts and using the pitometer to determine the amount entering each district has been described several times in Municipal Journal. Mr. Lanham showed lantern slides of some of the instruments employed, diagrams recorded by them, etc. He stated that in detecting leaks at service cocks, his inspectors used the aquaphone, preferring it to the more delicate microphone. Three members referred to the very satisfactory service given by a Darling instrument used for locating leaks as being very sensitive and locating a leak very exactly. Most of the leakage in Washington is found in service pipes, the great majority of them of black iron. Goose-necks have been found leaking at wiped joints and they are now set generally with lead flanges. The Waste Detection Service seldom has trouble with leaky valves, as these are kept in good condition by the Maintenance Department. The curb-cock boxes occasionally have to have the dirt removed from them before they can be closed in order to determine whether the leakage is beyond the curb cock or between it and the main.

Robert E. Horton read a paper entitled "Watershed Leakage," in which he explained by numerous illustrations and instances how the underground flow, especially around the edges of a watershed, did not always correspond with the surface or topographical watershed limits, water flowing toward the shed outside the topographical shed in some cases, and in others flowing from inside such a shed into the adjoining watershed.

In the afternoon Frederick E. Beck, chief engineer of the Consolidated Water Company of Utica, N. Y., gave some experiences in metering fire services, which was followed by the interesting discussion which this subject usually occasions in water works conventions. One member told of finding a detectometer which had been accurate when first placed, but after having been in service a year or two, failed to register large streams at all; but as one member pointed out, it was the registration of the small streams that most of them were after. Another member told of a block of wood becoming wedged in the compound valve and deflecting the flow into the proportional meter, causing it to register much larger amounts than actually passed. The company using the water had paid several bills on the basis of such registration, and when the trouble was discovered collected several hundred dollars of such over-payment from the water company. In the absence of William W. Brush of the Department of Water Supply of New York, Mr. Sherman read the paper entitled "Dangerous Reduction to Insulation Resistance in High Pressure Fire Service Motors Due to Moisture."

In the evening, D. A. Decrow, manager of the water works department of the Worthington Pump and Machinery Corporation, described the principles of the Unaflow pumping engine, which that firm is developing, and tests made of the pump, which had been installed at the Porter Avenue pumping station of the Buffalo water works. The pump is still undergoing a trying out and testing by the company, and final conclusions as to the efficiency obtainable have not yet been reached.

The final paper was one describing some tests made of joints in cast-iron gas pipe, described by a representative of the United States Cast Iron Pipe and Foundry Company, as a substitute for the paper by Creed W. Fulton, Mr. Fulton having been on guard duty in Boston and therefore unable to prepare the paper or to be present to present it. The tests referred to had been made at Schenectady, during the week prior to the convention, by the Schenectady Illuminating Company in an effort to determine the best type of joint to use in their new 12-inch gas pipe line, through which gas is to be forced under 25 pounds pressure for a distance of about twenty miles, to supply Troy, Albany and Schenectady. A line of pipe was made containing several joints, some of neat cement mixed quite dry, one of neat cement made wet, and one made by first caulking in tarred oakum, then cement, then more oakum and finally lead. Special bells were used containing two caulking grooves, but otherwise the pipes were standard pipe of the United States Pipe and Foundry Company. In the last described joint, one of these grooves came about in the middle of the cement part of the joint and the other in the lead part. This joint was still tight when the pipe broke under 600 pounds hydraulic pressure. The cement joints were fairly tight, and were practically so up to 25 pounds air pressure, only a slight amount of bubbling appearing when using the soap test. However, special pains had been taken by the workmen to make the cement joints perfect, and in view of the importance to the company that there should be no leaks in this line, it decided to use the cement and lead joint rather than the cement alone.

EXHIBITS

In connection with the convention, there was an exhibit of water works materials in the lobby and the adjoining parlors of the Ten Eyck hotel. The several booths were occupied with exhibits by the following firms: S. E. T. Valve & Hydrant Co., the Badger Meter Manufacturing Co., Hersey Manufacturing Co., Lock Joint Pipe Co., National Tube Co., Bingham & Taylor, Continental Jewell Filtration Co., Union Water Meter Co., Lead Lined Iron Pipe Co., United Brass Manufacturing Co., Pittsburgh Meter Co., Hays Manufacturing Co., Wallace & Tiernan Co., Inc., Electro-Bleaching Gas Co., Ford Meter Box Co., Joseph Dixon Crucible Co., Builders Iron Foundry Co., Central Foundry Co., Ross Valve Manufacturing Co., American City, Engineering News-Record, Fire and Water Engineer, Engineering and Contracting, Municipal Journal and Public Works, A. M. Byers Co., Eddy Valve Co., H. Mueller Manufacturing Co., Worthington Pump & Machinery Co., Pitometer Co., R. D. Wood Co., National Meter Co., National Water Main Cleaning Co., Thompson Meter Co., A. P. Smith Manufacturing Co., Neptune Meter Co., Carbic Manufacturing Co.

SCHOOL BUILDING PROGRAM

Editor, Municipal Journal and Public Works,
New York, N. Y.

Dear Sir:

In a recent editorial you suggest a number of questions that may be properly asked when considering a school building program.

It will occur to you that the maximum use of present equipment should also be required before any such program is undertaken. I therefore venture to suggest certain additional questions dealing particularly with high schools and which have resulted from recent investigations made by the Detroit Bureau of Governmental Research, to-wit:

1. What proportion of school seats of present equipment is used for each and every period of the school day? Maximum use cannot be required, but it is of interest to note whether there is only a small percentage of seats used at the early and late periods.
2. What relation does the size of the classes bear to the size of the class rooms? Class rooms seating thirty may be used by classes of fifteen, and every room be in use. Theoretically, the attendance could be doubled without additional class rooms.
3. To what extent is use made of special rooms? Recitation rooms really determine school capacity. If recitation rooms are not properly apportioned to study rooms, laboratories, etc., one may find such special rooms with large seating capacity being used only at small extent.
4. Has the space per pupil in special rooms,—laboratories, manual training room, sewing room, etc., been economically determined so that there is no waste?

It might be imagined that these questions of school administration would have long ago been determined with the same precision as is used in the space of factories. However, these simple tests applied particularly to high schools may produce some highly interesting and valuable results.

Very truly yours,

Lent D. Upson,
Director.

INANCES OF CITIES

Of the 227 cities of the United States having more than 30,000 population, during the fiscal year 1918 two-thirds spent more than their revenue for governmental costs, including interest and outlays for permanent improvements, the average excess being $3.48 per capita. However, the expenditures of the cities as a whole exceeds the revenues by only $1.42 per capita, and the expenditures for current expenses and interest only were $6.70 per capita less than the revenue.

Of the total revenue of the cities, 70 per cent. represents receipts from various kinds of taxes. Next to taxes, the public service enterprises furnished the largest item of revenue, this totaling $116,494,645 or more than 10 per cent. of the total. The payments for expenses of the public-service enterprises was $55,174,480, leaving a net revenue from this source of $61,320,165. The bulk of these earnings came from water supply systems, the receipts from these aggregating $90,139,705. The public service enterprise earnings averaged $3.39 per capita.

The net indebtedness for all the cities averaged $77.53 per capita. The total net indebtedness for New York City alone was $1,005,055,422, which is more than 60 per cent. of the total for all other cities of over 30,000 population, although the population is only about 16 per cent.

The above figures are summaries from a report soon to be issued by the Bureau of the Census entitled "Financial Statistics of Cities Having a Population of over 30,000: 1918."

OFFICIAL ADVERTISING

STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORK & BUILDINGS
DIVISION OF HIGHWAYS
Springfield, Ill.
NOTICE OF ROAD WORK
BIDS TO BE RECEIVED NOVEMBER 12, 1919.

Sealed proposals will be received in the office of the Department of Public Works and Buildings, Division of Highways, Springfield, Illinois, until 10 A. M. November 12, 1919 for the road work designated below.

Plans for all work may be examined in the office of the Department of Public Works and Buildings, Division of Highways, Springfield, Illinois, and plans for the work in the several counties may be examined in the offices of the respective district engineers as shown below:

Vermilion County—R. L. Bell, Buchanan-Link Bldg., Paris, Ill.

LaSalle, Will and Grundy Counties—J. E. Huber, New Clifton Hotel Bldg., Ottawa, Ill.

LaSalle County—A. H. Hunter, 302 Apollo Theatre Bldg., Peoria, Ill.

Macoupin, Madison and Bond Counties—C. M. Slaymaker, 510 Metropolitan Bldg., E. St. Louis, Ill.

Except as noted, alternate bids will be received for the following types of construction: Portland cement concrete; monolithic brick (4 inch brick); monolithic brick (3 inch brick); bituminous concrete with binder course (specifications C1, C2, C3, or CT); bituminous concrete without binder course (specifications C1, C2, C3, or CT).

Route	County	Sec.	Width Feet	Approx. Length
Danville-Hoopeston Highway	Vermilion	R	8	25,600.
*Morris-Henry Highway	LaSalle	I	19&30	13,460.3
*Morris-Henry Highway	LaSalle	U	30	8,369.
Joliet-Morris Highway	Will	E	18	41,475.
Joliet-Morris Highway	Will-Grundy	F	18	29,676.
Joliet-Morris Highway	Grundy	G	18	40,109.3
Springfield-E. St. Louis Highw'y	Macoupin	S	16	25,415.
Springfield-E. St. Louis Highw'y	Macoupin	T	16	15,830.
Springfield-E. St. Louis Highw'y	Macoupin	V	16	21,235.
National Highway	Madison	33	16&18	19,762.3
National Highway	Bond	34	16	19,307.
National Highway	Bond	35	16	23,864.7
National Highway	Bond	36	16&18	20,223.

*Earth road.

Cement will be furnished on all sections by the State or by the County.

By order of
The Department of Public Works & Bldgs.,
Frank I. Bennett, Director.

E. M. F.

S. E. BRADT,
Supt. of Highways.
CLIFFORD OLDER,
Chief Highway Engineer.

EQUIPMENT BARGAINS

BIDS WANTED
Noon. November 19, 1919.
Maquoketa. Iowa.

Supplying and erecting one, approximately 250 B.H.P. Diesel type engine direct connected to 210 K.V.A. generator with belted exciter, oil tank, pole and line material, switch board and station equipment, Meters, transformers, etc. Extension to building 46x35.

Bids will be received on the plant complete or on material f.o.b. Maquoketa, Iowa, except engine, generator and station equipment. Information from G. O. Morse, Supt. Maquoketa. Iowa, or W. E. Skinner, Engineer, Lumber Exchange, Minneapolis. Minn.

CITY ENGINEER WANTED

The Office of City Engineer of the resignation of the previous incumbent. City of Danville, Virginia, is vacant by Any Engineer of Municipal training and experience who desires to make application for appointment is invited to address the undersigned giving age, qualifications and such facts as may be material.

FRANK TALBOTT, Secretary.